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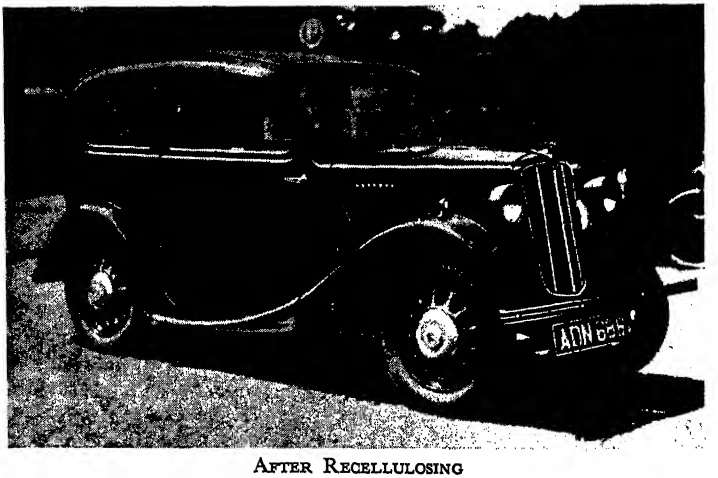

AFTER RECELLULOSING

Note the highly finished front wings reflecting clouds.

Frontispiece

CELLULOSE SPRAYING

A Guide to Finishing
Motor Cars and Other Metal Surfaces
with Cellulose and Synthetics

BY

JOHN HOWELL OUSBEY

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PREFACE

THE writer hopes that this book will help all who are interested in the finishing and refinishing of motor cars and other metal surfaces with cellulose or synthetics. In addition, the writer hopes that the book will serve to make clear to the general public that cellulose spraying is more than just "spraying over" with the spray gun.

No apology is made for the somewhat technical nature of Chapters I and XVI, which deal with the chemical compositions of cellulose and synthetics respectively. With a greater understanding of the materials being used there would be fewer mistakes and spoilt jobs.

Thanks are due to Dr. Harry Barron, Ph.D., B.Sc., F.R.I.C., A.I.R.I., for permission to use certain facts from his book, *Modern Plastics*, and to Morris Motors, Ltd., for the information given in Chapter XV.

J. H. O.

CONTENTS

Chapter 1

THE ORIGIN OF CELLULOSE

CELLULOSE is the oldest plastic material and in various forms has played an important part in the manufacture of everyday goods since about 1870. Its best known uses are as celluloid and photographic films.

The use of cellulose as a finish for motor cars does not date back very far: to the late twenties in England and a little earlier than that in America. Before the advent of mass-production methods in motor-car manufacture, coach painting was a quite satisfactory method of finishing the car bodies and its relative slowness did not matter a great deal. Faster production led to a demand for faster finishing, and as stove-enamelling methods could hardly be used on objects as large and unwieldy, not to say awkwardly shaped, as motor bodies, another method had to be found. Cellulose was the answer, since its properties were highly suitable—hardness, durability, and long life. It was found to be capable of taking a high polish and, above all, the process was quicker all the way through than paint and varnish, for the work could be handled as soon as finished.

There are three types of cellulose in use. Although for the average user of cellulose lacquers there is no means of identifying them, it is as well to bear this in mind for the important reason that most makers recommend their own brand of thinners for use with their lacquers. This is not sales talk but is based upon the fact that the three types of cellulose are not all soluble in all thinners or solvents. Each maker knows the best thinners for his own production, hence the instructions on the tins.

The first of the celluloses is nitro-cellulose or cellulose nitrate. This is prepared by the action of nitric acid on cotton linters in the presence of sulphuric acid, which acts as a catalyst and dehydrating agent. Cotton linters is the part of the cotton plant which is not used in cotton spinning. Nitro-cellulose is mixed with the necessary resins and pigments to form lacquer and can, of course, be used as clear lacquer.

The next one is cellulose acetate, discovered about 1865 by a German named Schützenberger. This is obtained by treating cotton linters with acetic anhydride and acetic acid, again in the presence of sulphuric acid.

The third and most recent cellulose is known as ethyl cellulose, and is manufactured from cotton linters or wood cellulose by the action of ethyl chloride. Its advantage over other cellulose esters is solubility in the cheaper solvents and its great degree of miscibility with synthetic and natural resins. Ethyl cellulose is unaffected by sunlight, has great stability under heat, and is very suitable for use as a cellulose lacquer.

Provided that he understands thoroughly the nature of the substance he is using, the painter can employ cellulose to make a very good job of a motor car, steel cabinet, or any other metal article. A mirror-like finish without scratches, specks, or "orange-peel" effect is the object when attempting cellulose spraying. A good knowledge of the old coach painting practices will be found most useful in building up surfaces and, of course, a coach painter has advantages over others in this respect.

Chapter II

THE SPRAYSHOP AND EQUIPMENT

THERE are three main requirements which a cellulose spraying workshop must satisfy. First, it must be situated away from residential buildings where the fumes would prove a nuisance; secondly, it must be capable of being cleared of spray vapours in a few minutes with a good system of fans, etc.; and last, it must be capable of being well heated. The factory inspectors will insist that the first and second requirements are met and the wise cellulose operator will see to it that the third is satisfied.

The construction should be of brick or stone or other fireproof material if at all possible. It will be found difficult to get an insurance company to accept the risk of insuring a workshop used for cellulosing if it is constructed of wood. The size of the business will determine the size of the workshop, but the following points apply equally to the largest and the smallest.

The writer believes that a long narrow shop is better than a short wide one, provided, of course, that there is room to move around the vehicles and their bits and pieces. A narrow shop makes it imperative to place either before or behind each car or van its own bonnet, wheel covers, and other odds and ends that have to be repainted separately, which avoids mixing up the various parts.

Assuming that, in a small business, not more than three men are working, either spraying, rubbing down, or cleaning, and that there will therefore be not more than four cars in the shop at once, a convenient size for the shop would be about 60 ft long by 15 ft wide, including

a small office or store in one corner; this could be upstairs in a two-storey building.

LIGHTING

As much daylight as possible should be the aim, for besides being cheaper than artificial light it is better for colour matching and for all work connected with the use

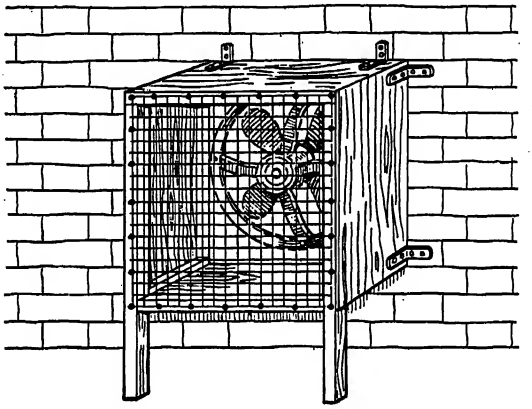


FIG. 1. FAN, ENCLOSED FOR SAFETY

of colours. Roof lights are the best, but ordinary windows in the wall should be included as well.

The floor will usually be of concrete or asphalt; but if funds permit the ideal floor material for a paint shop is one of the new rubber compositions, as this is dust-free, whereas concrete makes more dust each time the floor is swept.

The fans, of which there should be two or more, are best built into the most convenient wall which faces an open space and should be placed at from $2\frac{1}{2}$ to 3 ft from the ground; not higher, since spray dust falls rapidly. Each fan must have a wire guard over the blades, and the

apertures in the wall should have doors fitted on the outside so that when the fans are not in use there will be no loss of heat. (See Fig. 1.)

Where it can be arranged to have a part of the shop enclosed as the actual spray booth it will be found better for clearing the air by the fans. Two screens, one in front of and one behind the job, will be helpful if it is not possible to provide a permanent means of enclosing a part of the shop as a spray booth.

The compressor and distributor cleaner for the spray guns will be placed in the part of the shop most central and convenient from the point of view of getting around a job with the air-line.

All electrical cables, whether supplying power for the fans, compressor, etc., or current for the light fittings, should be in steel conduits and the electric lamps should be enclosed in fireproof covers. The meters and main switches should be fixed conveniently near to the door, so that whoever has to turn them off at night will not be obliged to feel his way around odd bits of car, etc., to the door. In any case the current should be switched off at the main each night.

FITTINGS

The fittings of a paint shop are many, and range from steel cupboards for the cellulose materials to blocks of wood for jacking up cars. Where space is limited it is as well to have some of the stock shelves placed rather high, and the others carefully arranged where they will be out of harm's way.

The bench for mixing paint and cellulose should be under a window and should be slightly higher than average table height (2 ft 6 in.) say 3 ft for the bench. It should be covered with sheet zinc, which is non-corrosive and easily cleaned down. Two or three drawers

underneath will be handy for storing putty knives, gun parts, etc.

Wheel stands are handy but not essential, whereas bonnet "horses" are indispensable. These should be of strong construction and shaped as shown in Fig. 2.

For use in jacking up metal jack stands are very useful, but wooden blocks have the advantage that they can be

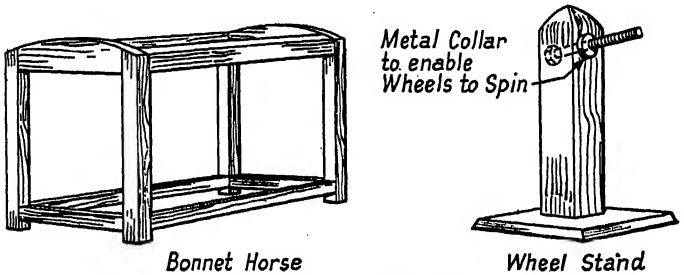


FIG. 2. BONNET HORSE AND WHEEL STAND

used under the most awkward types of spring or axle with safety. Needless to say, the blocks ought to be made of hardwood.

HEATING

A good heat is essential at all times for cellulosing if one is to avoid the worst of the snags, namely, "blooming." The best way of heating this kind of workshop is by means of a Beeston boiler and hot-water pipes running all round the building, except, of course, where the double doors are situated. The pipes should be placed, according to the height of the boiler, on bricks cemented together and so spaced as to afford good support to the pipes and not allow them to sag and thus strain the joints. During the winter months, fuel permitting, it will be wisest to keep the furnace in all night. No method of heating which involves open flame would be permitted by the factory inspector.

REQUIREMENTS OF ACTS

Copies of the Factories Act and the Painting of Vehicles Act (1926) must be displayed.

One of the main points required by the Factories Act is that the walls of the building should be limewashed or otherwise decorated once every fourteen months. The salient features of the Painting of Vehicles Act (1926) are that no paint containing white lead shall be rubbed down dry and that nail brushes, soap, towels, and hot water shall be provided at the rate of one bowl, etc., for every five persons employed in the work. In these days of rationing it will be necessary to obtain a permit for soap. Copies of the Cellulose Regulations must also be displayed and, since 1948, persons intending to commence cellulose spraying must notify the Factory Inspectors a month before date of commencement. The Local Council will furnish more information, as they are interested in the storage of cellulose solutions and will issue a licence for this purpose. Some time ago it was recommended that cellulose sprayers should have a pint of milk per day, but this is not a legal requirement, although on application to the local Food Office it may be granted.

THE COMPRESSOR AND SPRAY GUNS

The choice of compressor is determined primarily by the number of guns that will be in use at one time. The safe rule is to have the largest compressor that space will allow. To avoid the annoyance of having to wait while the compressor builds up again after spraying for a long period, it will be best to have an automatic stop and start device incorporated. This can be set to "cut out" at any desired pressure, but 100 pounds per square inch will be a suitable standard.

The compressor will be found to have a "blow-off"

tap to release the moisture that gathers from condensation inside the tank. There will also be one on the air-cleaner and distributor, which is the device whereby the dirt, oil, and water that are drawn into the compressor are trapped in a special bag contained in the barrel-shaped distributor. The "blow-off" taps should be opened every morning when commencing work, *before* starting the compressor; the condensate which has dropped to the bottom of the tank will trickle out. Then when the compressor is started up the air will force the remainder out.

The air-line should be a substantially-made rubber hose, well armoured to protect it in its career of being dragged across the floor, run over by car wheels, etc.

The gun, or guns, are a matter of individual choice. Some prefer the gravity-feed type, which has the cup or container on top. The main disadvantage of this kind of gun is that it cannot be tilted very much before the material starts to come over the side and ultimately down one's arm. The air vent or orifice in the lid of the container or cup must be kept free of dried cellulose or paint, which is the principal cause of stoppages.

Chapter III

PREPARATION FOR NEW CELLULOSE WORK

THE preparation of new work will fall under three headings—

(1) Newly built bodies for high-class motor cars.

(2) Specially built bodies for new vans, as distinct from those supplied as standard by the makers.

(3) New vans with the standard pressed steel body, but which have to be done in cellulose instead of, as normally, in synthetic.

The first two kinds of work require pretty much the same type of preparation.

NEWLY BUILT BODIES FOR HIGH-CLASS MOTOR CARS

Assuming the construction of the body is of aluminium with steel scuttle and wings and possibly a steel bonnet, proceed as follows—

Thoroughly dust out the job with the duster brush, removing from inside the body all sawdust and metal filings that might get blown on to the wet cellulose by the air from the gun.

If the body has been panelled in aluminium it will be scratched and filed well all round the edges of the panel, but the centres will probably be smooth and shiny. This part must be well roughed up with emery cloth to provide a "key" for the paint.

At this stage some prefer thoroughly to wash down with rags and turps substitute or petrol, to make a good job. This certainly will remove all grease, finger-marks, etc., from the metal, but there is still a danger in that when

steel, aluminium, or other metals have been welded, certain impurities are left on the metal which in time tend to raise the paint film. Particularly is this so with aluminium, for when welding aluminium the operator uses a flux which leaves behind a residue that turps or petrol will not move. It is therefore advisable to use A.C.P. Deoxidine or some similar cleaner based on phosphoric acid. This is dabbed on with a sponge or old brush and left for a few minutes to penetrate; the body is then washed off quickly with cold water, followed immediately by hot water, and is finally sponged and leathered off. When dry the job is ready for priming.

SPECIALLY BUILT VAN BODIES

Clear away all constructional debris on the motor-car body and inspect all mouldings, both screwed and nailed, to make sure that the screws are flush and that the nails are well punched home.

With a box-van body there is hardly likely to be a lot of aluminium welding and so Deoxidine is not really necessary. Merely use emery paper and turps or petrol, but be sure to wipe well afterwards for both these leave a residue if just left to evaporate.

Where the van body is very large, that is to say with sides of a big area, the panels may have been made from what are known as bonded sheets, sometimes called by some proprietary name such as "Plymax." These sheets are of thin galvanized sheet iron bonded to plywood and give a wood finish inside and the usual metal surface outside. They were in great use before the war for furniture vans and the like. Now it is well known that paint does not adhere to zinc-coated metals very well or for very long. The reason is that the zinc seems to have a chemical reaction with the oils in the paint and saponification takes place, that is the oil is turned into a soap.

Cellulose having no oil the reaction will probably be with the resins and pigments, but the results will be the same, namely poor adherence and peeling.

There are two ways of dealing with the zinc-coated surface, but both have the same object, to etch the surface with a "mordant" to prepare it for the film. The first and simplest is to get copper sulphate crystals, about a quarter of a pound to a gallon of water, which should be warm for the easier solution of the crystals. Apply this solution to the panels, which will immediately turn black. Leave to dry without sponging off, and then sand-paper and dust off with the duster brush. The panels must be primed at once.

The alternative mordant (to make one gallon) is as follows—

Industrial spirit	5 pints
Toluol	2 „
Carbon tetrachloride	½ pint
Spirits of salts	½ „

After application this mordant must be well washed with water and allowed to dry.

The last example given was that of a van with a standard body which had to be cellulosed. Some manufacturers use for their works primer an ordinary lead paint which is useless under cellulose and will have to be stripped off, whilst other makers use a hard, baked primer which can be cellulosed with perfect confidence that it will not "boil up." Experience alone can decide at a glance which is which and when in doubt the rule is—strip!

There will be no difficulty in removing this primer with an ordinary paint remover. The difficulty will be found in removing the effects of the paint remover and scrupulous care must be observed in washing off with turps or petrol, otherwise "soft" places will occur when

the cellulose is sprayed on. Vinegar is a good thing for cleaning down after using paint remover, but, of course, this also must be well washed off.

On this type of van it will probably be found that the wings are stove-enamelled and if this is so a very wise precaution would be to mask them up with a double thickness of paper before commencing to use paint remover.

The windscreen frames of some makes of van are stove enamelled in black and, if a black windscreen frame will tone with the colour of the van, by all means mask this as well; the masking can be left on until the job is completed, whereas that on the wings must be removed and new masking done before the priming and filling is commenced. This, of course, is to avoid having *any* paint remover left anywhere near the newly cleaned surface.

As soon as possible after the preparation and cleaning is completed get the job into priming, the methods of doing which are discussed in the next chapter.

Chapter IV

PRIMING, FILLING, ETC.

As soon as the cleaning operations are completed the work should be primed. How this is done will depend on which cellulose method is to be used for the job.

PRIMING

There are two methods in use, the oil undercoat system and the complete cellulose system. For really high-class finishes, and especially where the metal is bad, there can be no doubt that the oil filler method is the best if not the speediest. The all-cellulose system is quite good for pressed steel work; it may indeed be an advantage not to have very heavy paint films on surfaces which do not possess a great amount of "key." In the cases of specially built bodies, however, the oil filler will doubtless be chosen; this, of course, has to have an oil primer. Usually dark red in colour, these primers are so made that if need be they can be sprayed over with cellulose filler without working up and cracking, but normally they are used under an oil filler.

Apply the primer by means of the spray and thin if necessary with 10 per cent white spirit, but do not over-thin. Where the bare wood of the body frame is accessible spray this as well. This has to be done and it will make the job look tidy.

Leave to dry overnight and then go round all the worst places, cracks, screw-holes, etc., with oil paste stopper or a synthetic stopper. If this is done in the morning, then repeated about noon where necessary, the stopping will

be hard enough for the first coat of filler to be applied before the work is left for the night.

FILLING

The oil filler will need to be kept well stirred up and strained before putting in the gun container; failure to do this will lead to a clogged feed tube in the gun. The filler may be brushed on if the operator does not fancy putting oil filler in his gun. To brush oil filler, a light touch with the brush is needed and each coat must be laid off the opposite way from the preceding coat.

For a first-class job four to six coats of filler will be needed at the rate of two a day. When the last coat has been applied and the wet appearance has gone off it, the "guide" coat is applied. This is a thin coat, really a mist coat of contrasting colour sprayed over the filling to afford a guide when rubbing down. Where two types of filler, light grey and dark grey, are in use, the "guide" coat is simple; either the light over the dark or vice versa.

A good stain for filling can be made from a handful of vegetable black in a tin, a spoonful of gold size and a liberal amount of turps substitute or petrol being added to make a wash. When sprayed on, this is dry enough for rubbing in half an hour. Remember to make the "guide" coat very thin or it will be necessary to rub through what is virtually a coat of filler. The completed filling coats are left overnight to harden.

RUBBING

If manufactured rubbing bricks are available, these are the best means of rubbing down the filling; if not, wet-or-dry abrasive paper will be used, 180A or 120D according to the state of the filling and to whether it was brushed or sprayed. On large flat panels use a

felt or wooden block, so as not to leave ridges with the fingers.

Work clean! That is, wash off and leather each section of the job as you rub it; filling sludge left to dry on the body is very hard to remove successfully afterwards. If scratches occur see that they are rubbed away again with finer paper, say 240C or 280C.

When the guide coat has all been rubbed away the work should be level, provided that the fingers have not been used too much; by this it is meant that it *is* possible to eliminate the guide coat without properly rubbing the work. Thoroughly wash and leave to dry for from four to six hours when the job will be ready for cellulose filler.

The methods of filling with cellulose are the same as for the all-cellulose method, which is now to be dealt with.

CELLULOSE FILLING

For the all-cellulose system cellulose primer is used; but as was explained at the beginning of this chapter oil primer may be used and indeed, if the steel seems to warrant it, would be advisable. Of course, it has to dry overnight before cellulose can be applied. If cellulose primer is applied, the correct consistency is sixty parts primer to forty parts thinners.

To revert for a moment to the oil-filled job that has been rubbed down, it is quite possible that certain parts have been rubbed through to the bare metal, in which case they can be touched up with the cellulose primer before proceeding with the filler.

Spray one coat of the cellulose primer to the bare metal, and if the job has been stripped with paint remover watch for "soft" spots that do not dry. Should any of these places be really wet and look as if they will not dry, rub clean with thinners and re-spray that portion of

the work. The spots that are not so large and wet can be dabbed over with turps substitute or white spirit and left for an hour or so, after which they will be found dry and fit to take more cellulose.

After priming, several coats of cellulose filler may be applied in one day, five or six will be sufficient for most work; allow at least half-hourly intervals between coats.

The stopping-up process can be done on top of the

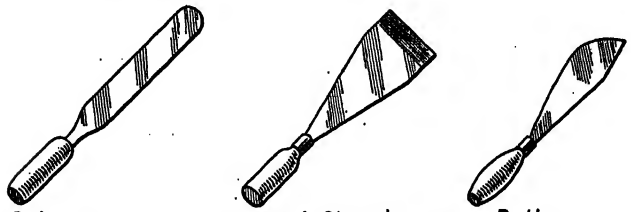


FIG. 3. KNIVES USED IN A PAINTSHOP

primer or left until after the last coat of filler. A guide coat of lighter or darker filler is then applied and it is advisable to leave overnight for the filler to harden.

Cellulose filler should not be rubbed with anything but wet-or-dry paper, and nothing coarser than 240C can be employed without the risk of scratches which will inevitably appear in the finish.

A word or two on cellulose stopping. Don't be tempted, because this stopper dries rapidly, to lay it on "thick and heavy." If you do it will only skin over and remain soft underneath for many days. Thin layers at intervals of forty minutes will make a better job of the stopping-up process.

After the rubbing of the cellulose filler, the job will be ready for the next stage, which is the application of surfacer and undercoats.

Three of the knives used in the paintshop are shown in Fig. 3.

Chapter V

SURFACERS AND UNDERCOATS COLOUR COATS

THE procedure from now on depends largely on the choice of colours for the particular job. After the rubbing or "facing" of the filler, blow out with the air-line around the mouldings, crevices, etc., to remove all moisture and then, taking a clean piece of cloth, remove all dust, streaky marks left by the leather, etc.

THE SPRAY GUN

Now that we are coming to the more important part of the spraying, a few words on the technique of using a spray-gun will not be amiss. Do not use the gun in an aimless fashion like a hose pipe, but work to a system and go round the job from the same starting point for each coat; the usual way is to start with that part of the canopy over the windscreen and to go right round the top of the car to the corresponding part on the other side. Next, spray all the rear portion of the car, including the boot door if there is one, then the doors, and finally the scuttle and front wings.

The spray-gun is held at a distance varying from six to ten inches from the work. The trigger is not kept constantly pulled back, but the gun is used in systematic "strokes" rather like a brush; but whereas with a brush one works up and down a panel, with a spray-gun one works from side to side (Fig. 4). When applying what is known as a "mist-coat" the spray-gun must be held at a greater distance from the work and moved over the job rather more rapidly than usual.

No mention has yet been made of any "masking" operations because we have been discussing new work which would not have glass in the windows, or lights or chromium parts to be protected. In the case of a new

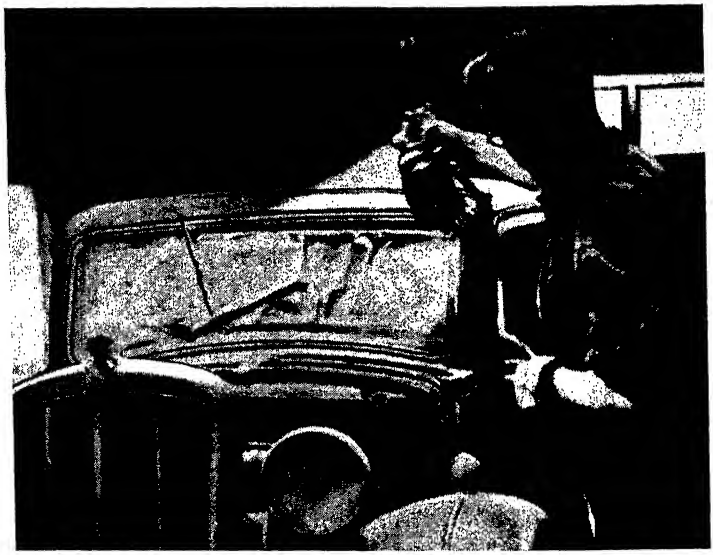


FIG. 4. SPRAYING DARK GREY SURFACER BEFORE COLOUR COATS ARE APPLIED

van there will, however, be a certain amount of masking to do (see section on "Masking" in Chapter VIII).

COLOUR COATS

When masked, the work is ready for the colour coats. Black is a popular colour, so we will deal with that first and with the more delicate shades later.

The primer surfacer, as supplied by most makers of celluloses, has a smooth silky finish and dries with a semi-gloss. Usually in two shades of grey, it makes an

dmirable undercoat, especially if tinted with some of he colour that is to be used for the finishing coats.

For black it is not necessary to tint the surfacer, unless t is the lighter grey colour, when it will be tinted with ome black. Spray two thin coats, one a mist coat. If he surfacer has been well strained there is no need for latting before the black goes on.

Black cellulose is usually sprayed at a consistency of ,0/50 with thinners. Some blacks, however, are unusually hick and opaque, in which case they can be thinned lown to 40/60, when they will still cover well. A good ob needs four to five coats of black at half-hourly inter- 'als. When completed it should be left overnight before ommencing to flat and overspray.

COLOURS

Greens. This colour covers as well as black, unless it s of the pale grey/green kind, and even that covers better han most pale shades.

Blues. Whatever the shade, these do not usually cover vell and it is advisable to spray thin coats and to put on s many as are necessary to secure perfect opacity.

Reds and Maroons. These require undercoats, a flesh- oloured or pink undercoat for red and a mauve shade or maroon. The maroons and lakes are dyes; and, s it takes a lot of lacquer to get a solid job in maroon, nore care is needed than with any other colour to avoid praying more coats on one part than on another.

White and Creams, including Yellow. Obviously these will ieed more coats to get solid than any other colour. Again thin coats and many of them are required; as with naroon, do not put one or two more extra coats on any ne part.

Polychromatics. These metallic finishes need a special echnique. Being composed of metal particles floating in

suspension in the cellulose lacquer, they must be kept well stirred up, and even during spraying the gun must be shaken up to ensure even distribution of the pigments and metal powders. Polychromatics are not sprayed with the usual side-to-side series of strokes, but the gun is moved in a circular fashion. Further particulars of this kind of finish will be found in Chapter XI.

Chapter VI

FLATTING AFTER COLOUR

THE most common fault with spraying is what is called "orange-peel" effect; it is sometimes glaringly bad in the work of inexperienced sprayers and is caused by the cellulose drying before it can flow out evenly. A good sprayer will adjust his material to the correct consistency and will cut down this "orange-peel" effect to a minimum.

The sprayer will discover as he progresses that if he can get a full coat on without its running, the cellulose then on will remain wet long enough to permit of a certain amount of flowing out, as with ordinary enamel when applied by a brush. The beginner is not advised, however, to attempt to put on full coats until he has thoroughly mastered *all* the intricacies of spraying. His only way of avoiding "orange-peel" is therefore to spray the cellulose as thinly as possible; that is, thinned to a consistency that will permit of covering but no more.

It follows that the more the colour coats required, as with creams, etc., the greater the possibility that there will be some "orange-peel" and consequently the more care will be required. There is also a greater danger of runs with light, delicate shades, as one is tempted to get the colour solid or opaque quickly and to pile the cellulose on, with the result that it sags and runs.

"Orange-peel" and other defects can be removed during flatting, the next operation, but there is less work if this sort of thing is avoided.

When the last coat of colour has been sprayed the job is left overnight. The need for this is not obvious when to all appearances the cellulose is dry and hard after about

an hour; the question naturally arises as to why it cannot be flatted after, say, two hours. The reason is that cellulose, unlike paint, dries by the evaporation of its thinners and as soon as these highly volatile spirits are gone the cellulose film is dry to the touch. Cellulose, however, contains other solvents less volatile than thinners and which take longer to evaporate, but which *have* to evaporate nevertheless, and the leaving of the work overnight ensures this evaporation before flatting and finishing.

FLATTING

The flatting is done with wet-or-dry abrasive paper 320C if marked "orange-peel" effect is present and 400A if free from this defect. The paper is lubricated with soap. Clean water and a sponge and leather free from grit are essential to success in flatting.

Use plenty of soap to lubricate the paper and avoid scratches, and rub until there are no more signs of pinholes, scratches, or other marks. Then sponge off and leather well to remove all traces of soap. Change the water frequently whilst flatting as it tends to become soapy.

During flatting operations keep away from sharp corners and edges from which one is liable to remove the cellulose and which would thus need to be touched up again. Provided that sufficient colour coats have been sprayed on there will be little danger of flatting through to the filler, but if for any reason there are not enough coats on when the flatting is carried out, proceed with caution and underflat rather than rub too much.

By this time the operator will be used to going around the job in a certain order and will flat and do all his processes in that order. An advantage of this methodical procedure is that one can note and remember the position of a little speck to be touched up here and a scratch to be rubbed out there. When the flatting is complete blow

out the moisture from all crevices, etc., with the airline and use the leather to absorb all surplus. Next take a clean cloth and carefully wipe away any smudges and bits of wash-leather, etc., and leave the job quite clean for overspraying.

Into the container of the gun pour three parts of thinners and one part of the colour and stir thoroughly. If possible prepare two containers in this manner. Now all that remains to be done to complete the overspraying is to spray as quickly as possible with this tinted thinners, which will heal all scratches occasioned by the flatting and will sufficiently soften all the coats and unite them as one.

Once more the work is left to harden overnight before the polishing and finishing, which is described in Chapter VII.

Chapter VII

POLISHING AND FINISHING

We come now to the final stage in the cellulosing of new work. The body of the vehicle has been cleaned, primed, filled, rubbed, filled again, and then cellulosed according to the owner's choice of colour and is now ready for the polishing.

POLISHING

Polishing of cellulose is done by abrasive pastes and rotary polishers, followed by waxes or liquid polishes for finishing off.

The abrasive pastes are made of natural earths suspended in some kind of emulsion with a glycerine base. They are called "rubbing compounds" by some manufacturers and "levelling pastes" by others. Care should be taken in the selection of cloths used for rubbing and polishing. Stockinet in twelve yard rolls is the material usually employed.

Cut off enough cloth to make three polishing pads of a size convenient to the hand; wet one cloth, dip into the abrasive paste, and commence to rub evenly and moderately fast. After a time the friction will cause the paste and moisture on the cloth to commence to dry and will give a gloss to the surface of the cellulose. When this happens take one of the dry cloths and rub briskly until all the paste has gone and then examine the work to see if it is good enough. The test of this is depth of colour and complete absence of "orange-peel" or scratches; there is no need to worry about brilliance at this stage.

Having satisfied yourself that the standard of polishing

s good, proceed to do all the body and other parts, loing small areas at a time and making sure that all the urplus and dried abrasive paste is rubbed off.

THE ROTARY POLISHER

The rotary polisher consists of a lamb's-wool cap or bonnet fitted over a felt pad on a revolving disk, which

FIG. 5. USING THE ROTARY POLISHER

may either be fitted to a flexible shaft driven by a stationary motor or on the end of a portable tool such as a sander or even a drilling machine (Fig. 5). A slow speed is best, otherwise accidents may happen and the cellulose film may be burnt or scored. When using the polisher adopt a firm stance and if compelled to stand on a box or on steps make sure that these are steady. The slightest slip whilst using the polisher will probably result in a

long scratch or burr that may not polish away but may have to be sprayed again. Used carefully, however, the polishing machine will give results that are surprising even to the old hand and can achieve a brilliance impossible by hand methods.

There are places, of course, which the polishing pad, being circular, cannot reach and these places have to have more attention with the liquid polish that follows.

FINISHING

At this stage a new car will have no further attention until after the fitting of door-handles, glass windscreen, etc., but other new work can now be lined. Methods of doing this are described in Chapter XV.

After lining, a final polish by hand with one of the liquid polishes will remove all last-minute finger-marks and the job is then ready to leave the paintshop. On new car work, where some time will elapse between the completion of the cellulosing and the finishing of other bodywork, such as glass fitting, etc., the polishing may be left until after all this work is completed. It is a good plan, however, to polish the screen pillars, and around window frames and sills before the car leaves the paintshop for the bodyshop, to ensure a good finish right up to the glass.

Chapter VIII

PREPARATION OF CARS FOR REFINISHING

THE recellulosing of motor cars is a much more complicated business than the cellulose finishing of new, straightforward work.

EXAMINATION

An important feature of doing refinishing is the ability to size a car up at sight and to estimate for the work. Wherever possible get the customer to leave the car for an hour or two so that a thorough examination can be made. This will obviate the annoyance of discovering extra hours of work for which no charge can be made because an estimate or fixed price was given at the time of accepting the job.

We will assume that a typical pre-war car has been accepted for recellulosing and a thorough examination from front to rear has revealed the following.

The radiator is chromium-plated and although dirty and stained would clean up; the same applies to the lamps.

The bumper bars have been painted and repainted time and again with wartime white, which is now flaking off and looks unsightly. The front wings are in good order except for one or two minor dents, which the sprayer can knock out himself if no panel beater is employed. The windscreen frame was black originally, but the rubber sealing strip is slightly perished; this fact is noted.

The body generally is in very good order, showing that the car has been well looked after. The rear wings will

need welding and straightening before the work is commenced.

The wheels are of the Easiclean type, of pressed steel with wheel-hub covers of chromium-plated steel, the chromium of which is found to be peeling and for which enamelling in synthetic is recommended. The cellulose film both on the body and wings shows no signs of the minute crazy look which would indicate that the cellulose is perished and would have to be stripped off with paint remover: it is for this reason that the examination is so necessary, for stripping adds pounds on to the price, because of the cost of both the labour and the paint remover.

DISMANTLING

After this examination the job can now enter on the first stage of preparation, which is dismantling of fittings.

Start with the door handles: of these the first to be removed is that of the driving door, which will have a lock incorporated. Because of this lock a grub screw or retaining screw will be found in the end of the shank of the handle, hidden by the upholstery. It is usually possible to prise away the rexine-covered plywood which constitutes the covering inside the door and to unscrew this grub screw. The handle is then detached from the body by unscrewing the outside screws. Wrap the handle with its screws and fibre washer in a piece of plain paper and mark it "O.S. Front." Place the little parcel in the cubby-hole of the dash or in the pocket in the door and remove the other door handles, marking their packages "O.S. Rear," "N.S. Front," and "N.S. Rear" respectively.

Boot or rear doors have handles that are sometimes difficult to remove; in doubtful cases it is wisest to leave well alone and to mask the handle.

The windscreen-wiper is usually capable of being

detached without much bother, provided it is understood how to replace it so that it functions.

The bonnet may have detachable chromium plated fasteners, and these can come off, as well as the studs in the bonnet tops (which prevent the top panels from scratching each other). Wrap these up and mark clearly.

The bonnet itself, of course, comes off, unless it is of the later pre-war type, where just the sides are removed and the top lifts up like a lid. In this case don't attempt to tamper with the delicately balanced hinge arrangements.

Take off the bumper bars next, easing the rusted nuts with penetrating oil where necessary. Examine the bars when removed to see if the number-plates, usually attached, are aluminium: if not, place the whole lot into the caustic tub when one is kept—and a caustic tub is a most useful thing in a paintshop. The bars can remain there until the job is almost complete, when the wartime white and all the old enamel will have been removed, but not the chromium. All that is necessary then is to take the bars out and to paint them after washing all the caustic away with clean water and drying the bars. Never put any aluminium object in caustic, as it will dissolve.

The next operation is the removal of the wheels. Jack up each wheel in turn and make sure that the car is safely on blocks or jack stands before taking off the wheel. The wheel nuts are, of course, slackened before taking the weight off the wheel. Stack the wheels neatly against a wall to await attention, marking the tyre of the spare with a big "S" in chalk. The wheel hub disks or covers, unless in very good condition, can follow the bumper bars into the caustic.

CLEANING

Now we turn to the operation that is called "getting rid of the dirty end," namely, cleaning the chassis,

inside the car, and the scuttle dash by the engine. For this dirty work it is advisable to wear industrial gloves and a cap to avoid getting dirt in the hair.

Wire brushes and scrapers will make short work of all the mud on the chassis and under the wings; if it is very greasy washing with paraffin with an old paint brush will help.

Clean out the interior of the car by removing all carpets, brushing out the floor; after beating replace the carpets, unless the floor is rusty, as it may be in an all-steel car.

The scuttle dash under the bonnet collects a lot of grease, etc., from the engine and it is as well to clean this part with paraffin or petrol. After thus cleaning remove all the resultant dirt from the paintshop floor. The job will now be ready for the next stage, which is the rubbing down of the body and wings. Before this is commenced, however, take a small brush and a tin of petrol or turps and wash the door edges and hinges, the groove near the scuttle where the bonnet fits, and any other places that look greasy.

RUBBING DOWN

The rubbing down of the old finish is done with 240C paper and 180D on the really rusty parts. These rust spots and cracks should be "feather-edged," that is, rubbed until the paint film tapers away to nothing where it meets the bare metal, and consequently shows every coat of filling and colour that was on the car previously. Rather like a contour map of hilly country, in fact!

As was described in the chapters on new work, go round the car in a methodical manner. If two men are on the job the usual way is for one to be on either side and commencing with the canopy over the windscreen to work along the top to the back quarter panels and so on.

During rubbing operations clean out the ventilators in the scuttle sides where fitted, open the windscreen and clean out the rust there also, and generally aim at removing all loose dirt before any operation that involves the use of the air pressure.

Before the bonnet is rubbed place it upside down on

FIG. 6. APPEARANCE OF CAR WHEN MASKED
The wheels have been covered with sacking

the floor and clean well inside with a wire brush; if it is greasy with petrol or paraffin. Place the bonnet on the bonnet horse and rub down.

MASKING

After rubbing down, blow all water out of mouldings, etc., with the air-line, and proceed with the masking. As the name implies, this means the covering up of

all places that have not to be sprayed, such as glass, chromium plate, rubber, etc.

This masking is done with three materials, paper (newspaper or brown paper), masking tape (an adhesive tape sold especially for the purpose) and masking paste which, applied to glass surfaces, permits the cellulose film to dry but not to adhere and allows for easy removal with a razor blade afterwards.

The tape, in widths of one or two inches, is used as one's ingenuity suggests, bearing in mind economy and effectiveness. You don't wish the tape to blow off on to a panel the first time you spray the job, so see that it is pressed well down and adheres. Car windows that wind down can be masked by trapping a sheet of paper in the top of the glass and tucking it down the channels outside, thus saving tape. Rubber sealing strips which are usually on fixed lights at the rear of the car, have to be kept free of cellulose; careful use of masking tape will ensure this. Fig. 6 shows the appearance of the car when masked.

When the exterior masking is being done do not forget the interior of the car, where the seats must be covered against the dust that settles. Place some sacking over the engine, as no car owner likes to see his engine sprayed with patches of filler and colour.

Chapter IX

PRIMING, STOPPING, AND FILLING

THE methods used in refinishing are slightly different from those described in Chapter IV, and more snags are to be expected than on straightforward new work. At this stage it would perhaps be as well to include a few remarks on priming after the use of paint remover.

PRIMING

Very little need be said about the actual use of paint remover, as the instructions on the tins usually give good results; but a lot can be said about getting rid of the paint remover afterwards, before attempting to put the work into primer and carrying on.

The more modern the car the more difficult it seems to be to get rid of paint remover; partly because of the use of all-steel construction, which when rusted allows plenty of hold to the remover, especially around wing edges, lamps, etc. It cannot be too strongly urged, however, that before priming one must make absolutely certain that all traces of the remover have been cleaned off.

If the wings have only been stripped and their condition does not seem to warrant the oil-filling method, the job can be carried out in the all-cellulose style and thus cellulose primer will be required under the filling. Use this primer fairly thickly on bare metal and all bare spots on the body, and allow half an hour or so for it to dry.

After the use of paint remover examine the primer for soft spots; if none is seen, the next stage can be carried out.

STOPPING AND FILLING

On refinishing work, especially with an all-cellulose method, the stopping is best done immediately after the primer and, when necessary, rubbed before applying the filling. If this procedure is not followed and the stopping

FIG. 7. SPRAYING CELLULOSE FILLER
The compressor can be seen in the background

is done on top of the filling, there is a tendency for the stopper to stand up from the surface when the colour is sprayed on. Add to this the fact that the stopper is much more porous than filling, and it will be seen that it is best to stop-up before spraying filling.

The amount of filling required on a refinished job will vary from two or three coats on the good panels to seven

or eight on really bad parts of wing edges. A guide coat will be necessary where more than four coats or so have been sprayed.

On very rough places such as wing edges and door bottoms a good method is to spray on one or two coats of filler as thick as it will come through the gun. If this is done the thick filler will have to have special attention when rubbing down.

"Orange-peel" effect can be kept down to a minimum even with filling; but, of course, filling cannot be sprayed on as thinly as colour, so a fuller coat is the only way to avoid "orange-peel." Watch out for runs when spraying full coats of filler as it has a tendency to "hang" and then to drop down in curtains on vertical surfaces. If this happens a lot of rubbing will be required to level the runs.

When full coats of filler are applied it should be remembered that on old work the wet cellulose will soften up the old film and, if this is much perished, will lead to crazing and cracking. This can be avoided if the first two coats are just mist coats and barely solid before the first of the full coats is sprayed on (Fig. 7).

Cellulose fillers being heavily pigmented have a tendency to clog the spray gun and especially the vent hole in the top of the container. Constant attention is required to keep this free. Always clean the gun and containers used after spraying filler. If care is not taken about this one of the annoying results will be that when colour is sprayed bits of filler will blob out on to the work, necessitating further flatting.

Chapter X

RUBBING DOWN AND SURFACER CO

CELLULOSE filler is never rubbed with any other but wet-or-dry abrasive papers and the correct for filling are 280A, 240C, and for rough place The stopping is rubbed down with 180 paper ar it is under the filling the surrounding places sh rubbed again with 280 paper to remove scratches reference has been made to the using of wa abrasives, so perhaps it is appropriate to men correct and most economical way to use them.

The sheet, which measures 11 × 8 inches, is fol cut into four. A piece will thus measure 5½ × and is then folded again along its longest side. U way it is a convenient size for the average hand abrasive being on both sides will not easily slip the hand (Fig. 8).

For most rubbing operations the abrasives are conjunction with soap and a little is rubbed or wetted paper as often as necessary, but not so oft make the water in the bucket or on the job too During the rubbing operations the water in the should be changed at least three times, as this keep the sponges and leathers clean. On large the paper must be placed over a wooden or felt block to avoid finger-marks in the filler which show through the colour coats.

There is no need to throw away any piece of dry paper until it has been used several times; stance, a piece of 180A used for stopping will st enough cutting power left to be used on cellulo

so the paper should have the colour washed off and should be placed in a separate box.

SURFACER COATS

When the rubbing is completed and all sludge and dirty water have been removed by washing the job well,

Fig. 8. Using Wet-or-Dry Abrasive for Rubbing Down

blow out the water from all the usual parts such as lamp fittings, wing piping, etc., then take a piece of clean rag and wipe all over. The work is then prepared for colour by means of surfacer coats, to act as sealers to the filling, which tends to be porous.

Where the primer surfacer as made by the manufacturer is available, this should be used at a consistency of 65 per cent surfacer to 35 per cent thinners. Two medium

to full coats will "body up" the surface sufficiently and make a good start for the colour.

Should no primer-surfacer be available a surfacer undercoat can be made. Into a gallon tin which has had the mouth part cut off put about three pints of filler; tint this with the actual colour to be used until it is a shade or two lighter than the finishing colour. To this add thinners to make for ease in straining and strain into another clean tin. Thin this mixture to the consistency of 60/40 and spray on two coats.

It should be noted that it *is* essential to strain this home-made surfacer, because there will be no further flatting before the colour goes on, and therefore the work must be free of bits of filler, etc. It also follows that the nearer the tint of the surfacer to the intended finishing colour the better it will be for the covering power of the latter.

The surfacer coats should be left to dry for about one hour before it is attempted to spray on any colour.

Chapter XI

COLOUR COATS

BEFORE attempting to spray any coats of colour the gun should be cleaned well, especially if it is the one that was used for filling.

The container usually has a groove at the bottom which harbours the solids from fillers and other heavily pigmented cellulose. If the container is not kept clean the new colour will work up anything in this groove and the gun will spurt it out on to the freshly sprayed surface.

Not all cellulose lacquers have finely ground pigments, and after stirring it is as well to make a practice of straining all colours into a clean tin. For this purpose old silk stockings are better than a paint strainer, as they can be thrown away afterwards and they will serve to strain everything but the thickest filler. Never put cellulose into a tin which previously contained paint or synthetic; if possible, use an absolutely new tin.

Draw at least 2 gallons of cellulose thinners into gallon cans and the spraying of the colour can be commenced. The first coat is a mist coat consisting of 35 per cent colour and 65 per cent thinners and one quart-size container full will usually prove sufficient to go around the average car with this coat (Fig. 9). Allow fifteen minutes to dry.

The next and subsequent coats are 50/50 colour and thinners, and as the job appears to become well covered and solid the coats can be sprayed on more fully. This is done by holding the gun nearer the job and for a slightly longer period at one place.

After about three coats, if time permits, a light flat may be given to remove any specks or to face out any runs. Next proceed to spray on the other two or three coats as the case may be.

The remarks made in Chapter V about colours and shades apply equally to old refinish work, but here is a

FIG. 9. SPRAYING THE FIRST COAT OF COLOUR

special caution about the use of pale creams, etc., on old jobs. If this type of colour cannot be avoided on an old car, beware of tar-base blacks used for touching up on wing edges. These will bleed right through the filling and show as a dirty yellow in the delicate tint of the new cream or light grey used for refinishing. Naturally, these places should have been seen during the preparatory work, but mistakes do happen and tar-base blacks have a quite remarkable tenacity. If the tar-base black does

show through, a slight smear with french polish sometimes seals the spot, but if this fails the only remedy is to cut right out and stop up again.

POLYCHROMATIC COLOURS

As remarked in Chapter V, these lacquers consist of minute particles of aluminium or bronze floating in the tinted cellulose lacquer. When first done a car resprayed in polychromatic looks very well, but there is the disadvantage that it is not possible to blend in when touching up, owing to the fact that it would be impossible to get exactly the same degree of consistency a second time.

When spraying this type of finish, use a circular motion with the gun and shake up from time to time to avoid settling. Clean the gun well after use of polychromatics.

The spraying of any bright red is best done when the shop is empty of other work; if this is not possible cover everything well. Red spray-dust seems to bite into other cellulose more than any other colour and, of course, should the surface on which it has settled be sprayed in cream afterwards the red would bleed through.

A rough guide to the number of coats of colour required, given the necessary undercoats, is as follows—

Black (no undercoat)	4 to 5
Greens	4 to 5
Blues	6 to 8
Greys	5 to 6
Reds and maroon lakes	8 to 10
Creams	8 to 10 (and until solid)
Polychromatics	6 to 7 (according to shade)

After the final coat the work should be left to dry overnight before commencing to flat down.

Chapter XII

FLATTING AND FINISHING

Upon entering the final stages of the work greater care must be exercised to avoid mistakes, for they will now be less easily rectified and will delay the completion of the work.

FLATTING

After spraying the colour coats and allowing about fourteen hours to harden off, the work is flatted with either 400A or 320A and soap, using clean sponges and leathers.

During this flatting operation try to keep away from all sharp edges such as bonnet louvres and edges, as if laid bare they will have to be retouched with colour after polishing, or "blown in" before overspraying, in which case these same places may again be rubbed through whilst polishing.

Providing that enough colour coats have been sprayed on the job there should be no occasion to be nervous about giving the work a good flatting, getting the surface free from all minute scratches, "orange-peel," etc. Use plenty of soap and there will be no flatting scratches; never use a piece of paper that has been dropped on the floor as it will be full of grit, which will scratch the cellulose. Wash off each section with the sponge as it is flatted, and dry with the wash leather.

PREPARATIONS FOR POLISHING

After flatting go around the job with the air-line in one hand and a wash-leather in the other, blowing out

all water from the mouldings, etc., and wiping them with the leather.

The job is now "oversprayed" to heal the tiny scratches caused by the flatting, restore the surface to its glossy appearance, and make for easier polishing. This is done by making a mixture of 25 per cent colour and 75 per cent thinners and giving the work a fairly full coat all over as rapidly as possible. The aim is to get a uniform appearance all over when the work is sprayed, as this makes for easier polishing. When the spraying has been done, leave the car alone for an hour or two for the cellulose to dry and settle.

The next job is to take down the masking and clean up before polishing. When removing masking from windows make sure that the film which has extended from the actual work to the paper on the windows is cut, otherwise it will pull away some of the new cellulose film and make more last-minute work. Where masking paste has been used on the glass remove the heavier film with a razor blade, either in a holder or with a bit of tape along one edge to avoid cut fingers, and wipe off the remaining paste with a rag soaked in turps.

The windows should now be cleaned, as much for the enhanced appearance this gives as for any other reason; it seems to make the car a lot nearer completion. Cellulose abrasive compound makes a good window cleaner and used in conjunction with a razor blade to remove all traces of spray-dust will make the dirtiest glass sparkle like new.

If it is intended to paint the door edges with cellulose (using a brush, that is) now is the time to do them, for should any cellulose be dropped accidentally on to the wings or run down over the top of a door on to the panel, it can be made right before the car is polished. However, to guard against this risk, cover up any exposed places where cellulose might drop, and put a coat on the edges.

Cellulose is brushed with a soft mop and its rapidity of drying may be retarded either with special retarder thinners or with a spoonful of castor oil. This enables a flowing coat to be brushed on the edges and leave no brush marks. It is not advisable to attempt to brush edges in cream or maroon. In these cases, if they cannot be sent out black, mask up well and spray along with the job. Badly finished door edges mar an otherwise well-done job, and spray-dust on upholstery always shows up the careless sprayer.

Sometimes door edges are too bad to be repainted with cellulose, in which case it is as well to do them with synthetic or other gloss enamel. Should it be decided to do this the edges will be painted at the last when all polishing is finished and the resultant fluff removed. Allow one night, of course, for the synthetic to set hard.

When the carpets are removed for cleaning, as described in Chapter VIII, it may have been discovered that the floor, if metal, was rusty. If this is the case, now is the time to paint the floor with lead colour; replace the carpets when the paint is dry.

The next operation is to remove the coverings from the engine, cover up the front wings and paint the tool-boxes, radiator tank, or any other parts of the engine that are usually painted black. All that now remains before polishing is to paint the chassis and under sides of wings black. This is usually done with chassis black which, being a tar-base black, must be kept off the edges and outsides of wings. After painting the chassis wipe all black off the wheel nuts and greasing nipples.

Some prefer to paint the chassis at a convenient time during spraying operations but as spray-dust gets on to the black the chassis loses its freshly done appearance and therefore this job is better left until the last.

POLISHING

The masking and cleaning disposed of, the next operation is to polish the whole car with abrasive paste in order to burnish the surface to a high finish. As with all polishing never tackle too large an area at once.

Abrasive paste is used as follows: cut off the roll three large pieces of cloth and fold one into a pad of a size convenient to the hand, damp this and smear on it some abrasive paste, apply to the job and rub steadily either backwards and forwards or in a circular fashion. When the cloth seems to drag and become dry a shine should be appearing on the work. Now take one of the other cloths and rub briskly to remove all the paste and loosened pigment and a clear bright surface should be the result; if not, repeat the operation.

Experience will enable you to know just how much rubbing is required. Do not be alarmed because the cloths become stained with colour; this is quite normal with cellulose, for cellulose lacquers are pigmented right through and not covered over with any protective film of varnish as in ordinary paintwork.

Avoid the use of too much water as this tends to carry the paste into cracks and behind wing piping, etc., leaving unsightly white marks which are not easily removed.

The abrasive will bring the cellulose up to a fairly good gloss, but the next stage of polishing, with the machine, will give a sparkle and burnished appearance that is remarkable.

The lamb's-wool mop used on the machine should be clean and well tied on. If the operator has never used a polishing machine before, he would be well advised if he tried it on a part that is easily made right, such as the top part of the door or a bonnet side, before attempting bigger panels. Keep the mop flat on to the panel wherever

possible and apply steady pressure (Fig. 10). Do not let the mop approach too near hinges or other projections which if caught might lead to disaster.

Should the polishing mop be retained in one place too long a burn may result, for remember the cellulose is

FIG. 10. WHEN THE ROTARY POLISHER IS USED THE MOP IS KEPT FLAT TO THE WORK, AS SHOWN HERE

not yet bone-hard. Despite all these snags and potential disasters the machine polisher is a great help and no operator should be put off from using one just because of the greater care needed. The machine will not be able to polish certain parts, such as the inside section of front wings and near to door hinges, so after using the mop go around the car with a liquid polish and pay special attention to the places where the mop has not been. Polish off briskly with a dry cloth.

FINAL DETAILS

The car is now ready for the completion of details as lining (which is dealt with in the next cha replacing wheels, door handles, etc. It is attenti detail which makes the completed job look well.

Provided their position does not interfere with t the line, the door handles can now be replaced, an car should always be standing on its wheels befo lining is done.

Sunshine roofs of leather-cloth should not be sp with cellulose (unless in cream, which would be h match in synthetic), but should be brushed at this with gloss enamel or synthetic of the required c The channels of sunshine roofs are done at the sam as the door edges.

Other details to watch are the white streaks left b hinges, etc., by abrasive compound. These can be tively removed by means of a dab of penetrati applied with a small brush, the surplus being wiped

Abrasive compound is marvellous stuff for pol chromium-plated parts such as lamps, radiator b bars, and windscreen frames, and will remove a brown spots commonly thought to be rust, but whi merely a deposit *on* the chrome and not bitten int

Finally, paint all door edges, if to be done in syn and replace the bonnet. The next day, after the edges are dry, the car can be delivered to the custo

AN ALTERNATIVE METHOD OF FINISHING

Where the metal surface of either a car or other p steel work is in good condition, the following alter way of cellulosing may be adopted. Strip off the e finish with paint remover and ensure perfect cleanli described in previous chapters.

Proceed with primer and filler as for the a style on new pressed-steel work, and follow up to and including the surfacer coats. Be su the surfacer when spraying and thus obviate a facing and flatting before the colour goes on. of colour are now sprayed on fairly full at a of 60/40 per cent and with three-quarters of drying time between coats. Blues or maro have three or four coats at this stage.

The next operation is a good flatting with g and soap. Do not worry about rubbing th now, as more colour is to go on.

Should the cellulose used dry matt, then cl must be added before carrying on with the The proportions are to one gallon of cellulose pint of lacquer, that is, 8 to 1. Of course, if th is already glossy no clear lacquer will be need

After the good flatting operation more colou on at a consistency of 55/45 per cent, rather th usual—but put on as a full coat so as to allow th peel" spray-marks to flow out. Two to four co ample according to the shade of colour. The should be a good-bodied high finish, and th left overnight to allow for evaporation of th and thus to harden.

Finally, a fairly thorough flatting down paper and soap follows, and instead of being o with a mixture of 75 per cent thinners and 2 colour the work is sprayed with a full thin coa at a consistency of 65 per cent thinners to 3 colour.

It is in the polishing and finishing that the of this method show themselves. There is no r abrasive paste. The machine polisher does all ing on the accessible parts and a liquid polish w

up other places such as round windows on car work. Provided that the spraying has been skilful and the machine polisher is used carefully, there should be no difference in the appearance of a surface finished this way and one finished by the laborious method of using abrasive paste. More care is necessary, however, to keep the cellulose free of specks both in the can and on the work, as the machine picks these bits up and scratches other parts with them.

The places that are not machine burnished must be just as brilliant as those parts that are, and liquid polishes will bring up the desired finish.

The methods described in this chapter also apply to the application of half-hour synthetic enamels. These enamels come under the Cellulose Regulations as they are really nitro-cellulose synthetic resin enamels.

The final coat of half-hour synthetic is usually sprayed as a "double-headed" coat, that is, one coat of high viscosity enamel followed by a wet coat of thinner consistency before the first coat has dried.

Chapter XIII

MASKING FOR TWO-COLOUR WORK

THE operations described below are carried out during the spraying of colour coats, but as the subject is an important one it deserves a chapter to itself.

More care is necessary when masking for two or more colours than when just masking glass or chromium from which, in case of accident, the cellulose could be removed with razor blade or thinners.

There are three ways of masking for dual colours, or rather three different types of material used. The first is tape and paper, either newspaper or brown. A poster printer is a useful man to contact for supplies of paper. Printers often have waste which is admirable for the job.

As an alternative to tape, "gumstrip" can be used and has certain advantages over masking tape which will be described later. This gummed paper is available in sizes from one to four inches; three inches is a suitable width for our purpose. Tape and paper are expensive items and as they can be used only once economy is the order of the day when masking.

The third way, used mainly on new work or repetition jobs, is to employ thin metal or wooden templates held in place by means of a handle, or in some cases held by an assistant.

The usual system of two colours on motor cars is either (*a*) the body one colour and the wings a contrasting or harmonizing colour; or (*b*) the body a different colour from the waistline up or down, such as lower panels cream and upper portions black, or lower panels light grey, upper dark grey. A decision as to which

colour is to be sprayed *before* masking has to be made before the colour coats are commenced. Two considerations will help in forming a decision: first, whether one colour will require more coats than the other, as with cream; and second, whether there will be a great deal more of the car to be done in one of the two colours. For example, some cars have all the upper part and

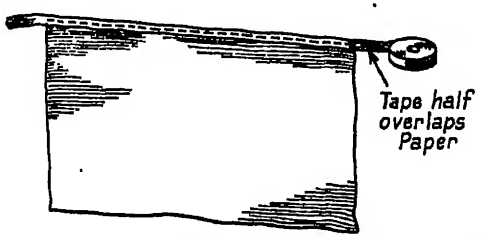


FIG. 11. THE METHOD OF FIXING TAPE TO PAPER FOR MASKING

wings in black, say, and the lower panels in green; in a case of this sort obviously the green is done first and then masked off. There will be so much less to mask than if the black was done first. Where cream or white is to be one of the colours or shades this is sprayed first; these colours require many coats, and when cellulose piles up on paper it sometimes causes shrinkage and the masking will come away.

After the first colour has been sprayed, flatted, and oversprayed no attempt should be made to mask until the next day, otherwise there is a danger of plucking away the new cellulose with the tape when unmasking.

MASKING WITH TAPE AND PAPER

The procedure with masking tape is to take a strip of tape of one inch width and apply it to a piece of paper so that half is adhering to the paper and half is free, as in Fig. 11. The length should be that most convenient

to the operator. With the tape and paper in both hands approach the line of demarcation, usually under or over a moulding, and press the masking on, in as straight a line as possible, smoothing down with the thumb until the tape adheres firmly, as in Fig. 6. Adopt this method for all the straight parts of the work and mask all these parts first. For the curved places around the wheel

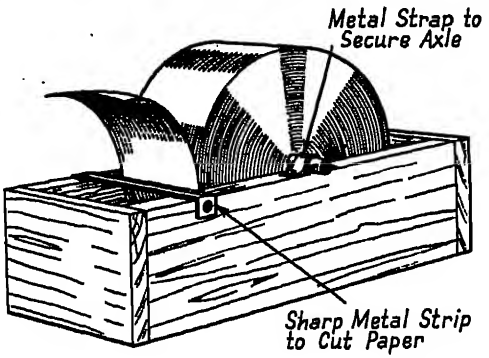


FIG. 12. A HOLDER FOR GUMSTRIP ROLL

arches the tape and paper are employed in smaller lengths and the area is built up with a number of pieces.

It is advisable to cover up *all* the freshly sprayed portions of the car to prevent the spray-dust finding its way in between folds of the paper, or over the edge if insufficient paper has been attached to the tape. Where the upper and lower papers meet fasten them together with small pieces of tape here and there. This will prevent the papers blowing about under the air pressure. The window and other masking, of course, is left in position until the whole car is completed.

MASKING WITH GUMSTRIP

The second method of masking is similar to the tape method except that the gumstrip is used. Gumstrip is

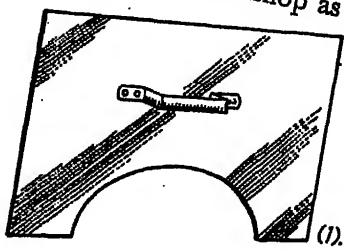
not so simple to use but if the following system is adopted no trouble will be experienced. Purchase or construct a holder for the roll of gumstrip. Fig. 12 shows a typical holder, which has a blade attached to cut off the lengths of paper. Keep this holder (and all the masking materials) on a small table or cupboard top, together with a tin of masking paste and an inch brush, a small piece of old sponge, and a box of old razor blades. When masking with gumstrip the paper is not attached to the strip before affixing to the car but the following method is employed. Cut off about half a dozen eighteen-inch lengths of gumstrip and place them one by one on the bench or table top, gummed side uppermost and paste each strip down half its width with a fairly thin coat of masking paste. Place the strips so coated on one side; the fact that they appear to dry does not matter. When using on the work, the pasted part of the strip is wetted with the sponge and placed in position on the car, the pasted half to the top, and the lower half of the strip is then folded back to allow the newspaper to be inserted underneath. The gummed but unpasted half is now moistened with the sponge and pressed down on to the newspaper or other masking paper. The advantages of gumstrip become obvious when the curved places are masked, because the strip being pliable has a certain flexibility and stretch, and a very much cleaner line is therefore obtained.

Where this method of masking is used it will be found best to mask just before spraying; then the cellulose, going right on to the gumstrip before it has had time to dry out, will seal in the moisture and thus make it easy to remove the paper and gumstrip when desired. If this is not done and the masking paper dries, the gumstrip must be soaked with water before attempting to remove any masking. These precautions will not be necessar

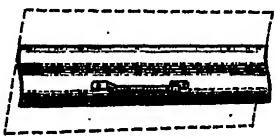
with ordinary tape as the adhesive is of a non-drying, tacky nature.

MASKING WITH TEMPLATES

The third method of masking is hardly suited to a general refinishing paintshop as it employs template and



(1). For Wheel Arch



(2) For Straight Lines, 'Raked' to stand away from job

FIG. 13. TEMPLATES FOR MASKING

stencil masks. As different makes of car have different shapes of moulding the expense entailed in having templates made for each kind would be heavy. However, where repetition cellulose work is carried out, as on kitchen cabinets in two or more colours, they will be found most useful. Templates should be made as light as possible, especially if they are to be held by the sprayer in one hand while he holds the gun in the other. Aluminium sheeting is admirable provided it is reinforced in the centre by means of swages or other strengthening devices. A handle must be provided at a suitable point (Fig. 13).

Masking paste alone is not recommended for screening in dual colour work. Being porous it is not completely safe and should not be risked on good work.

Chapter XIV

TREATMENT OF WHEELS; LINING

THE painting of wheels is always a trying task on a refinish job as they are usually in bad condition. Where time allows and the owner agrees to the extra charges, sandblasting is the ideal way of making the wheels ready for recellulosing. Unfortunately, however, as this involves taking off the tyres and sending the wheels away for an indefinite period, it is seldom possible to have this done; so other means of cleaning must be used.

CLEANING WHEELS

There are three ways of cleaning wheels which are very greasy and rusty: first, the old slow method with spoke brushes, petrol, paraffin, and rags; second, the greatly improved way of soaking them with one of the patent detergent oils; and third, a slower method (but not so slow as sandblasting), stripping in a caustic-soda tank in the workshop.

The first way needs no explanation. For the detergent oil system, which is best done outside, flop on the oil with an old brush and leave for an hour to soak. Wash off each wheel with clean cold water, using plenty of water. Leave the wheels to dry and if they are not too rusty the painting can be carried out when properly dry.

If caustic soda is to be used, remove the tyres and the rubber band which protects the tube from the spoke ends. Place all the wheels in the tank, which should be so constructed that they can be totally immersed. It will be found that a 40-gallon tub or oil cask will hold five

wheels on top of each other. For a tub of this size which, of course, will only be half full of caustic solution to allow for displacement, 28 pounds of caustic soda (sodium hydroxide) will suffice. Always add caustic soda to water, and not vice versa. One night's immersion will completely strip the wheels when the solution is fairly new. The next day they must be thoroughly washed with water. A hook for fishing the wheels out of the tub will prevent splashed hands. After the water has dried off the wheels, a wash with clean petrol or thinners is an added precaution.

PAINTING WHEELS

So much for the cleaning; now for the painting of the wheels. For refinish work and on all but the best wheels it will be wisest to paint the wheels in a synthetic enamel of the right shade. The synthetic enamel, suitably thinned, can be sprayed. The advantage of this is that oil primer and oil filler can be used without any cellulose filler afterwards and the enamel, having more covering power than cellulose, tends to make a better job. Pressed steel wheels in good condition will repay spraying in cellulose, especially if the colour would be hard to match in synthetics.

Obviously no polishing can be done where wheels are concerned (except, of course, on wheel disks); so the last coat of cellulose colour carries a lot of clear lacquer to give a good gloss.

Wheels which have been stripped with caustic or sandblasted should have the tyres replaced after the coat of primer is sprayed on. After the wheels are dry and before putting them on the car the tyres are painted, either with special tyre paint or with a composition made by working about half a pound of vegetable black into a paste with gold size until all powder effect has

gone. Add petrol or turps substitute, to thin to brushing consistency. If the tyre paint is desired to be a grey colour, add a little flat white. Brush on the tyre sparingly, just enough to cover the sprayed parts. Do not paint a heavy coat on, or when the tyres flex themselves on the road the tyre paint will flake off and look unsightly for a time. Painting the tyres makes the wheels look neater, and the tyre paint has no detrimental effect on the rubber.

LINING

This section has been left until after the treatment of wheels for the express purpose of emphasizing that the wheels must be on the car and the car standing on level ground before a line is put on.

The usual places for lines are either on, above, or below mouldings on private car work, and the modern tendency is to run two fine lines parallel to each other and about quarter of an inch apart. On refinish work the old position will have been noted before the car was rubbed down and the line replaced there.

The curves on modern pressed-steel bodies do not allow the use of the chalk line for marking-out, and so another method is used. A pair of draughtsman's compasses or dividers are needed, plus a piece of brown paper about 4 × 1½ inches with white chalk rubbed on the rougher side. The points of the compasses or dividers are fixed at the desired distance from the moulding by testing, then locked or otherwise tightened. Holding the paper in one hand, chalked side to the job, and the dividers in the other, proceed to mark aline round where necessary.

The painting of the line is best done in cellulose, slowed down in drying for this purpose by means of retarder or castor oil. However, as those inexperienced in lining would find it difficult with cellulose (it cannot be

wiped off, for instance) an alternative is to use synthetic enamel, which stands up to hard wear and polishing.

The actual lining is done with the "lining pencil" and palette illustrated in Fig. 14, and the method of using the pencil is to hold it between the thumb and

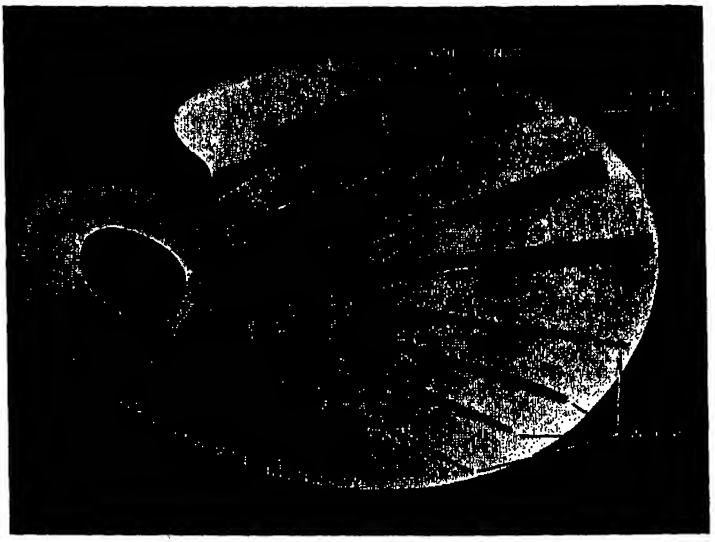


FIG. 14. PALETTE AND LINING PENCILS

first two fingers and charge it with colour from the palette by drawing the liner across the colour which has been previously dabbed on to the palette. A small dipper of turps is kept handy in case the colour thickens or commences to dry on the palette. The laden pencil is brought to the job, quickly laid on the chalked line and drawn along with a steady but swift motion. The other fingers of the hand that holds the liner are run along the top or bottom of the moulding as a guide and to steady the pencil which has a tendency to jerk about:

a regrettable tendency, the beginner will find! Fig. 15 shows how the pencil is held and applied to the work.

Practice on some panel that is not important will give

FIG. 15. LINING

Note that the palette is in the left hand and that the fingers of the right hand are used as a guide

confidence before attempting to line a car for the first time.

There are two ways of lining in gold (1) by mixing gold or bronze powder in a medium usually sold with these powders and lining with this mixture, which must be kept well stirred; or (2) by running in the line with gold size to which a little chrome yellow has been added,

and when tacky dusting over with gold powder on a piece of cotton wool, finally washing off all surplus gold powder, and varnishing.

A lining or striping machine gives better results on new work than on refinishes, and the possessor of such a machine should follow the instructions carefully.

Chapter XV

CELLULOSING NEW MASS-PRODUCED CARS

THIS book would not be complete without reference to the cellulose processes used on a large scale in motor-car manufacture. The time element and the continuity of the flow of vehicles being the first considerations it is obvious that the cellulosing methods used in a motor-car factory must differ from those used in the small workshop engaged on the refinishing of motor cars and vans.

The painting processes described here are those used by Morris Motors, Ltd., at Cowley, where the cars are assembled, the component parts having been made elsewhere. Painting is the first operation and is done before any other parts are added to the bodies; this makes for ease of working as there are no windows or other fittings on the body.

The bodies, on which the doors have already been hung, come to the paintshop by overhead conveyor and are in bare metal. All high spots and bumps in the metal are located and sanded level. Cleaning off grease and oil and treatment with a rust preventive follow. The body, mounted on its trolly or bogie, is then pushed to the start of the half-mile-long painting conveyor line, where the endless chain catches the underside of the bogie and draws it along to the first spray-booth. Here an operator sprays on the first coat of primer and the body continues towards the next booth. The distance between spray-booths is just long enough for the primer to be air-dry as it reaches the second spray-booth.

Each spray-booth is a self-contained paintshop with

enough space on either side of the car body for the spr to move around in comfort. A powerful extractor is situated above the body as most of the sprayin above two feet from the ground. The cellulose is fe the gun from a large pressurized tank, which has

FIG. 16. SPRAY-BOOTH AT MORRIS MOTORS, LTD., COWLEY
Showing conveyor chain and bogie on wheels. Note the exhaust fan overhead
(*By courtesy of Morris Motors, Ltd.*)

automatic agitator to keep the material from settli The pressure used to feed the guns is eighty-five pou per square inch.

On reaching the second booth the body receives first coat of filler and proceeds to the next booth, wh a second coat of filler is sprayed on. From here the b is conveyed into a long oven where it stays for some ti at a temperature between 230° and 250° F. This bak ensures that the filler will be hard and dry when

body emerges from the oven and comes into the "rubbing down" section.

Here several bodies are rubbed by gangs of men wearing rubber boots and aprons. Plenty of water is used and the filler is rubbed with wet-and-dry paper. After rubbing, the body is dried off and passes to a spray-booth where the bare spots, if any, are touched in with primer and the whole body is given a coat of a red sealer or surfacer.

Again the body enters an oven, but not for so long this time, and when it emerges the sealer is rubbed down to remove any roughness or spray marks. The work is now ready for colour and the edges of doors and around window openings get an extra coat before the four coats of colour (if black) are sprayed on, one after the other, in as many spray-booths as is necessary. When all the colour is on, the body enters another oven at a slightly higher temperature for about the same length of time as for baking on the filler. The body is hard and dry when it leaves this oven and passes, still on the conveyor, to the flatting section, where the colour is flatted in exactly the same manner as described in Chapters VI and XII.

After flatting, all edges and places which are liable to wear are given another coat of colour and the body passes on to the last spray-booth where the operator sprays (or, rather, oversprays) it with thinners. Then the body enters yet another oven until hard, and passes through into the polishing section. Polishing is done by hand with abrasive paste and cloths and then the body is burnished by the machine polisher, as described in Chapter VII.

The final stage is lining, which is done with a striping machine which can put on two fine and one broad line at the same time. However, there are some parts of the car body where the machine cannot be used, so a man follows round with a lining pencil and palette, joining up the lines. The body now leaves the paintshop and

goes off to be assembled as a complete motor car in the other departments.

The wings (or radiator shells) are stove-enamelled, and a special department is employed on this work. Several months may elapse between a wing being pressed out and the same wing being enamelled, and all wings unpainted are stored covered in oil or grease to prevent rust. When the time comes for the wings to be stove-enamelled the first operation must therefore be to remove all this grease. Degreasing is done by means of caustic soda and the wings, hooked on an overhead conveyor, are totally immersed in the caustic. The grease is removed effectively and the next stage is to get rid of the causic. Hot water is the secret of neutralizing the effects of the caustic soda and then the wings are dried by means of the heat of the shop, which is at a fairly high temperature.

Following the cleaning operations the conveyor takes the wings through a tank containing over 5000 gallons of black stoving enamel and then lifts them out. They drain over draining trays from which the surplus enamel runs back into a 30,000 gallon storage tank. After all the surplus paint has drained away the conveyor takes the wings into a stoving oven where the coating is baked on at a high temperature. This dipping and stoving process is repeated three more times, until an exceptionally high finish is obtained which is very hard, a desirable quality for wings which have a lot of rough treatment in their lifetime.

The wheels, of the pressed-steel Easiclean type, are stove-enamelled in the same manner as the wings. Before the wings are fitted to the new car body the wheel arches are painted with black paint applied by brush.

When the new car is finally completed, all greasy finger marks are polished away and the car stands resplendent in its finish, ready for the market—home or export.

Chapter XVI

FAULTS AND THEIR REMEDY

FAULTS and snags occur more frequently than in pre-war days, mainly because most cars are in a bad condition after so many years of neglect. However caused, almost every fault has a remedy and careful workmanship will ensure that a particular fault does not occur again.

RUNS

These occur because inexperienced sprayers hold the gun too long at one part of the job, and an accumulation of cellulose gathers which cannot hold up before drying. The treatment is to wait until the cellulose coat is thoroughly dry and face down with 280C paper and soap and water. Respray the bad portions.

BLOOMING

Damp weather and lack of heating in the workshop lead to blooming. Damp weather cannot be altered, but draughts can be excluded and the temperature raised. After this is done the simple remedy is to spray the work over with thinners only, when the bloom will disappear and, provided the temperature is maintained, will not occur again from this cause. The use of one make of cellulose and another make of thinners can be a cause of blooming for which the remedy is obvious.

CRACKING AND CRAZING

Should the surface of the cellulose develop cracks in the course of any of the operations the cause may be one of two things.

(1) Where the refinish is being done with oil filler over the old surface suitably prepared and primed, the oil filler may crack because too many or too heavy coats have been applied. The remedy for this is to rub down a second time and thus make the film thinner. Thick cellulose filler sprayed over the defects will then make the surface good.

(2) With an all-cellulose refinish the rubbing down in the first operation seems to liven up the old and perished cellulose sufficiently to enable it to be a source of trouble when the new cellulose is sprayed on. The cracks or crazy parts show themselves when the first wet coat of cellulose, either primer or filler, goes on. The remedy is to leave for an hour or two and spray some medium/thick filler over the worst parts, leave overnight, and rub down well. After rubbing, mist coats only should be used for the first two or three coats.

PEELING

This fault occurs usually after the car has been on the road a week or two and shows itself in small patches which can be scraped off with the thumb nail. The cause is insufficient preparation and cleaning, and the only remedy is to flat down the bad places and respray. At the same time look for any other places where this peeling may occur: round the wheel arches is a common spot. This type of defect will usually only occur on refinish work and not on new work.

NON-DRYING

When the cellulose does not dry after the normal length of time the reason may be one of several.

Wet patches of cellulose following the use of paint remover indicate that there is still some of the stripper left under the primer, and the remedy is to cut out the

affected part with a putty knife or scraper and clean with thinners, rub the edges of the patch with abrasive paper used *dry*, and respray with primer; then apply cellulose stopping to level the surface.

Other causes of non-drying are grease and oil which have found their way on to the surface of the panel and have been overlooked. Natural grease from one's hand is sometimes enough to prevent the cellulose drying, so try to avoid placing the bare hand on the surface after it has been prepared for spraying. In these instances there will be no need to cut out with a knife, a wipe over with a thinners-soaked rag will remove the top coat of cellulose and the grease, after which leave to dry and face with 280C, used wet.

GUN STOPPAGES AND CLEANLINESS OF GUNS

Should the gun refuse to function at all, or the spray dwindle to occasional spurts, the most likely cause will be dried cellulose affecting some working part. The first place to examine is the vent hole in the top of the container cover; this hole soon becomes clogged owing to the splashing of material inside the container. Keep a needle near to where the gun is hung and clean the vent immediately before using the gun. If the gun does not spray after clearance of this vent then the stoppage is due to clogging inside the needle chamber or feed tube.

To clean the needle chamber take off the screwed cap, which serves both as a cover for the needle and its seating and as a spreader to form the fan-shaped spray, unscrew the needle-valve seating, which is a core-shaped fitting, and drop these two components into a tin of thinners. Now pull back the trigger and the blast of air should dislodge anything in the mixing chamber above the container. Take the fittings out of the thinners, clean well with a small brush and replace.

The gun should now spray satisfactorily. If not, then the trouble must be in the feed tube, which is the narrow raked tube that extends almost to the bottom of the container. Remove the container and examine the gun to ascertain in what manner the feed tube is assembled. This is very important to ensure correct replacement. Dismantle, clean with thinners, and reassemble; the gun should now be perfectly satisfactory.

From time to time the gun should be dismantled completely, and the parts left in a large tin of cleaning solvent or thinners over the week-end.

Chapter XVII

PREPARATION FOR SYNTHETICS

WHAT are synthetics? And how do they differ from ordinary paints and cellulose?

Synthetic enamels have for their base a synthetic resin instead of, as in oil enamels, an oil varnish. The synthetic resins used in enamels are the same materials as those from which the new and popular plastics goods are made; but these resins were in use for paint and enamel manufacture a number of years before the war.

The principle of drying with synthetic enamels is different from both cellulose and ordinary paint. Cellulose dries by evaporation, first of its highly volatile thinners and solvents, and then by the slower evaporation of the remaining solvents, until the film hardens. Paints and ordinary types of enamels dry by the chemical change wrought in them when the oils oxidize or combine with the oxygen of the air to form a skin. Linseed oil, for instance, oxidizes to form what is known as linoxyn. With synthetic enamels, when applied to a surface, by either brush or spray, a change occurs which is called "polymerization." Polymerization is defined as a reaction in which two or more molecules of a substance unite to form a new substance, the molecular weight of which is a multiple of the first substance. In other words a chemical change occurs which would appear to change the liquid form of the resin to a solid right through instead of just forming a skin as with other enamels. The resultant coating is, in effect, a plastic coating and is very hard, after twenty-four hours certainly as hard as cellulose; and synthetic enamels or varnishes can be polished,

not so soon as cellulose but after about a week or so. However, as they start with a high gloss the only object in polishing synthetic is to remove the "painty" look from the finish.

The main group of synthetic resins used in motor-vehicle enamels is the alkyd or glyptal resins. The principal raw materials for alkyd resins are phthalic anhydride, which is obtained by heating phthalic acid to 213° C., its melting point, and glycerine, a by-product of the soap industry. The resins produced are prepared with suitable drying oils and pigments to make the enamels.

A synthetic finish is similar to cellulose in that every coat from primer to finishing coat has the same base and they "bond" together to form a tough impenetrable film. The synthetics have also the added advantage that, on certain kinds of work several coats can be applied "wet on wet" in one day and rubbed down the next day.

Used under ideal conditions, synthetics are much better in many ways than cellulose and before the war one manufacturer of motor cars turned out several new cars thus finished. Another make had all coloured wings, that is other than black stoved wings, finished in synthetic enamel.

Occasionally the coachpainter or cellulose sprayer is called upon to estimate for a refinish on a car whose owner does not wish to pay the full price of cellulose work. This would be a case in which to suggest finishing in synthetic, which can be done for a lower price than cellulosing. Of course, this is the normal procedure for most van and lorry work and those who usually do this work in addition to cellulosing will experience little difficulty in spraying a car with synthetic enamel.

To prepare a car for synthetic the same amount of care is needed to remove grease and oil as for cellulose

work. Remove all fittings as described in Chapter VIII, and after cleaning the door edges and other places where grease accumulates, rub down with 240C and soap and water. There is no need to be quite so finicky about every scratch and mark as there is quite a lot of filling power in synthetic undercoats. After rubbing down and drying off, the car must be masked up as completely as for cellulose work; it is well to note that masking paste should not be used on glass when spraying synthetics, as the sprayed film sometimes does not dry and thus becomes a source of trouble in later rubbing or flatting operations.

The masking complete, the bare spots are "blown in" with oil primer, and the car left overnight. Any stopping that may be necessary is done the next day with oil paste filler or synthetic stopper, and the stopping is levelled when hard with 180A used with soap and water.

The car is now sprayed with one coat only of oil filler modified to make a surfacer. This is done by adding to the oil filler sufficient synthetic varnish to make the filler flow out when brushed. This is tested by brushing a full coat on a piece of metal. The quantity of varnish must only be small, just enough to enable the filler to flow out and no more, as it must still dry flat. Thin with turps substitute to a spraying consistency and spray carefully to avoid runs and sags. If the filler has been modified correctly it will flow out, leaving no "orange-peel" effect. The correct air pressure should be about 50 pounds per square inch.

The work is again left overnight to dry and is then rubbed lightly with 240C, wet. When it has dried off and all water has been blown out of mouldings the car is ready for the spraying of undercoating and finishing coats.

From now on the utmost cleanliness must be observed

in order to keep the surface free from "nibs," the coach-painter's name for the specks of dirt, pieces of fluff, etc., that mar the surface of a high-gloss finish. The two most important factors in keeping the work clean are (1) having the materials used constantly stirred up and frequently strained, and (2) spraying the car in the cleanest part of the shop away from doors that are continually opened and closed, as this leads to currents of air and dust.

Gun cleanliness, of course, is as important as for cellulose work.

Chapter XVIII

SPRAYING SYNTHETIC ENAMELS

THE next stage in refinishing a car with synthetic is applying the undercoatings. It is most essential that an undercoat be used with all synthetic colours, with the exception perhaps of black. Having no gloss but possessing good hiding powers, they give a richness and depth to the finishing coat that cannot be achieved otherwise, short of applying three coats of finishing enamel.

A disadvantage of most synthetics is that they skin heavily in the can when once opened, so to avoid this it is best to incur the added expense of buying the enamels and undercoats in quart or half-gallon containers. In these sizes the whole canful will be used on a job and there will be no waste due to skinning. When it is not possible to purchase the enamel in these sizes one way to avoid skinning is to cover the remaining enamel with a layer of turps after use and before replacing the lid tightly. This turps can be stirred into the enamel when put into use next time.

USING THE UNDERCOATS

When it is not possible to obtain the correct undercoat for any given colour, remember that all undercoats must be a shade or two lighter than the proposed colour, and pick the most suitable undercoat accordingly.

Stir well and strain if the material seems to be at all gritty. Thin with about 5 per cent of synthetic turps, or with the proprietary thinners recommended. Next, go all round the car with a clean non-fluffy cloth to remove all traces of dust and grit, and proceed to spray

on the undercoat. Start at the off-side front canopy, e.g. over the windscreen, and spray on just enough undercoating for the surface to look wet. Go all round the top portions in this way, finishing at the corresponding spot on the near side. The door panels are done next, and finally the wings and rear lower panels, boot door, etc. Be careful not to go over any place twice, as is permissible when spraying cellulose; it is a good plan to have a clean two-inch brush ready to catch up any runs. If runs do occur *stipple* them away rather than stroke out as when painting.

After spraying this coat of undercoating colour leave the car for about five hours at least, preferably overnight, and when dry and hard lightly skim the surface with 280A wet-or-dry paper, used dry. Clean off the resultant powdery dust with a brush, *not* in this case with the air-line, and the first coat of synthetic colour may be applied.

FINISHING COATS

The enamel must be well stirred but it should not be necessary to strain the finishing colour upon first opening. The matter of spraying consistency for finishing coats requires some thought and deliberation, as the consistency must vary to suit the temperature and according to whether it is the first or final coat of enamel. In cold weather, when difficulty is experienced in maintaining heat in the paintshop, a good plan is to keep a pan or container of hot water and place the enamel tin (with the lid raised) in this. The heat will thin out the enamel to a spraying consistency and when the warm enamel impinges on the cooler, heat-conducting metal of the car it will start setting before runs occur. Consequently a fairly full coat can be sprayed with confidence.

On the other hand, in very hot weather the enamel

will be thinner on account of the heat and will flow out even more when it is sprayed on to the warm surface of a car. In these circumstances no turps or synthetic thinners will be needed. At other, more moderate temperatures, however, up to 5 or even 7 per cent of turps or thinners can be added, 7 per cent for the first coat.

Synthetic enamels must be sprayed at pressures from forty to sixty pounds per square inch; higher pressures mean that the air will disturb unnecessary dust which would later settle on the work.

Spray carefully, remembering that any part overlapped or gone over twice will have a double quantity of *wet* enamel which cannot possibly hold up until dry and the result will be a run. Of course, overlapping in some places is unavoidable and the two-inch brush must be kept within reach so as to stipple out any runs as they are seen. Be sure that the brush is clean and worked into colour before using it for this purpose.

When the spraying of the first coat is completed, leave the car and avoid going near it, so as not to raise a dust. To this end the spraying of enamels is best done as the last job of the day, when the place can be left. When it is hard, which it will be in about eight to twelve hours, the first coat of synthetic enamel is flattened with 320A and water, using soap as a lubricant of course. It will be necessary to flat only the centre parts of panels as a skim will suffice for the corners and around hinges, just sufficient to take the gloss away.

VARNISHING

Wash and dry off as usual, blow out water from the mouldings, and the car will be ready for the second coat of synthetic colour. This time spray a rather fuller coat with, of course, a more careful watch for runs. If preferred this coat may be of varnish or clear synthetic

should the colour be suitable, that is, not a delicate shade of blue, cream or light green. The varnish may be sprayed in exactly the same manner as the coloured enamels, or may be brushed if the shop has the necessary varnish tackle (varnish brushes suspended in linseed oil), but brushing is recommended only if the operative is accustomed to good-class varnish work and can get a clean finish.

However applied, the varnish will dry slightly harder than the enamel and the next day can be flatted for the final coat of varnish; this time flat with pumice powder or 400C and water. To flat with pumice a piece of felt is needed and the pumice is used wet. A convenient way is to have the pumice in a small box made with a compartment to hold the felt. Wet the felt and dip into the pumice and rub carefully on the panel until all gloss is gone. Great care is necessary to wash away all the pumice after flatting operations.

If the only grade of pumice obtainable is of the coarser variety it will have to be "levigated" which consists in separating the finer particles from the coarse. Pour the pumice powder into a vessel of clean water, when the heavy coarser powder will sink to the bottom; when it has settled pour off the water which carries the finer particles in suspension and strain through blotting paper. The powder will remain on the paper and is then ready for use.

Where the work is to be given a final coat of varnish, any lining is done after the flatting of the first coat of varnish or the second coat of colour; the final coat of varnish will then effectively seal the line.

The varnish, or clear synthetic as it is sometimes called, is now sprayed on and left to harden. Two days' hardening is desirable if possible. Door edges and other details are then attended to and the wheels sprayed and replaced, thus completing the work.

SPRAYING VANS IN SYNTHETIC ENAMEL

When the cellulose sprayer becomes more proficient in synthetics he may decide to take on van and other commercial work. Spraying a van with synthetic enamel is done as follows.

Rub down the maker's works primer with 180C (wet), and mask up all chrome, windows, and wings if they are to remain black. The modified filler will hardly be necessary on a new van with a metal body. Instead, one coat of synthetic primer is sprayed on and, when dry, lightly sand-papered to remove roughness.

The undercoat, suitably thinned and strained, is sprayed on; one coat for most colours, two or more coats for light colours. Once again lightly sand-paper, with a smooth grade of paper of course, and dust off with a duster brush followed by a clean, non-fluffy rag. The finishing synthetic is sprayed next and when hard dry is well flatted with 320A and soap and water. It is this flatting operation which makes all the difference to the quality of the finish on a new van. Follow the flatting with a second coat of colour and, again when hard dry, flat with 400A (wet). Lining and lettering are now done and the final coat of varnish is applied by brush. The masking is removed when the last spraying coat is hard and before lettering, etc., is commenced.

The references to varnish ought not to be taken to mean that synthetic enamels *must* be varnished. On the contrary synthetics are hard and glossy enough to provide a tough, hard-wearing surface even if unvarnished. For van work, however, where there will be lettering to protect, varnishing is essential. The lettering will be varnished separately with a writer's "pencil." Delicate shades of colour are not usually varnished for fear of deepening the shade.

Lettering is outside the scope of this book, and in any case a signwriter will usually be called in to undertake the lettering of a van, but a study of harmony and contrast in colours will be helpful in suggesting colour schemes to customers.

Synthetic finishes may be polished after about a month or six weeks of hardening. Gently polish at first with a soft wax polish and later on use a liquid polish to remove any road film. During the hardening period plenty of told water when washing down the car or van will assist the hardening.

Recently some makes of popular cars have been finished in a stoved synthetic process, but as this method involves elaborate equipment and organization it is beyond the scope of the average refinisher.

Chapter XIX

GENERAL REMARKS

To prevent the sprayer from inhaling the fumes of the cellulose, masks should be provided in every sprayroom and their use encouraged, though some sprayers have never worn a mask and have apparently suffered no ill-effects. Spectacle-wearers will find that the prolonged wearing of a mask will dim the lenses of their spectacles owing to condensation. The only way to cure this seems to be by use of one of the patent anti-dim ointments (used for respirators during the war). Where more than one person does spraying in a shop each will have his own mask or masks in the interests of hygiene. The masks should be cleaned inside with one of the ordinary germicides.

QUANTITIES OF MATERIALS

To assist in costing and estimating the following tables have been prepared, not as a rigid guide but to give a good idea of the average proportion of materials used on any job.

NEW WORK

Large Car or Van

Oil primer approx.	1 quart
„ stopper „	4 pounds
„ filler „	1 gallon (6 coats)
Cellulose filler	1 gallon at least
Surfacer	½ gallon
Colour	1 to 1½ gallons
Thinners	4 to 5 gallons
Turps substitute	½ gallon
Polishing cloth	1 roll
Chassis black	1 quart
Wet-or-dry paper (assorted grades)	1 dozen sheets
Masking tape	½ roll

REFINISH WORK

Large Car, all cellulose

Cellulose primer	1 quart
„ stopper	2 pounds
„ filler	1 to 1½ gallons
Surfacer	½ gallon
Colour	1 to 1½ gallons
Thinners	5 gallons
Sundries, polishing cloth	¼ roll
Chassis black	1 quart
Wet-or-dry paper	1 dozen sheets
Masking tape	½ roll.

Small Car

Cellulose primer	1½ pints
„ stopper	1 to 2 pounds
„ filler	¾ to 1 gallon
Surfacer	1 quart
Colour	1 gallon
Thinners	3 gallons
Polishing cloth	½ roll
Chassis black and paper in proportion	
Masking tape	½ roll

It will be found that certain materials are used in larger proportions than others according to the condition of the job; for instance, a large car may have the body in such good condition that very little filler and no stopper is needed, but the wings may be so bad as to necessitate heavy stopping and filling, which will bring the quantity up to the same amount as if the stopping and filling were used all over the car.

The quantities of synthetic materials needed for car or van work are approximately as under.

Medium-sized Car or Van

Primer	1 to 1½ pints
Filler (modified)	1 quart
Undercoat	1 quart to 3 pints
Synthetic finishing colour	½ to ¾ gallon
Turps substitute	½ gallon
Varnish (synthetic)	1 quart
Sundries: wet-or-dry paper, soap, and pumice powder	

TIME REQUIRED FOR A JOB

The following tables of times for operations are, for convenience, compiled on the assumption of two men working together on a job. Thus for operations such as rubbing, where more men are engaged, the number of

NEW WORK ON CARS, 2 MEN EMPLOYED

Operation	*Day*	*Time in Hours*
Clean down, primer	1st	4
Stopping	2nd	2
2 coats of filler per day	3rd	1
	4th	1
	5th	1
Rubbing down	6th	8
Cleaning out, touching in with primer	7th	3
Cellulose filling	8th	5
Rubbing	9th	6
Surfacer coats, and some colour	10th	5
Colour spraying completed	11th	4
Flatting and overspraying	12th	8
Polishing and finishing	13th, 14th	12

Total: 14 days clear, 60 hours.

REFINISH, ALL CELLULOSE ON MEDIUM-SIZED CAR, 2 MEN EMPLOYED

Operation	*Day*	*Time in Hours*
Dismantling	1st	12
Wheels off and rubbing	2nd	
Masking up, primer	3rd	9
Stopping	4th	9
Rubbing, stopping		
Re-prime and some filler	4th	8
Complete spraying of filler	5th	4
Rubbing	6th	6
Surfacer and some colour	7th	6
Spraying colour	8th	5
Flatting and overspray	9th	8
Polishing door edges, etc.	10th	8
Reassembling, lining, and details	11th	9

Time required is: 11 or 12 days to carry out work, less any welding.
Total hours: 75.

hours will be cut down, but not necessarily the number of days. Conversely, where only one man is on the job he may possibly complete the rubbing in, say, a day; and therefore the time in days will remain unaltered.

More hours are needed to complete the refinish than the new car or van, owing to the greater amount of cleaning and the dismantling, etc. It will be understood, of course, that where several cars are done at the same time part of the hours worked will be put in on another job. For instance the sprayer filling up the work on the fifth day will allow intervals of half to three-quarters of an hour between coats, during which time he will apply stopping to a car which is at its third day stage. For accurate costing in such cases time-sheets should show how the hours worked are apportioned.

The cost of the work, then, is arrived at as follows.

(1) Cost of materials to nearest gallon or pound actually used. This means that if a pint of filler thinned with thinners remains in the gallon can then one gallon of filler has been used.

(2) Cost of labour.

(3) Proportion of overheads (rent, rates, and electricity, etc.), chargeable to the particular job. These will be the amounts normally paid, divided by the number of cars or vans worked on at one time. Thus, if rent and rates together are £2 per week and two cars are done together then each car accounts for £1 overhead in this respect for each complete week the car is in the workshop, and *pro rata*.

As the price for the job is fixed at the time of estimation, the profit depends on how the owner of the business keeps down the costs, consistent with doing the work well.

VARNISHING OVER CELLULOSE

This is a subject on which few coachpainters agree, and certainly the idea of applying varnish over cellulose

does seem opposed to all that is taught regarding the uses of paints and cellulose. The writer, however, has seen a van which was cellulosed in blue and, whilst unpolished, had been given a clear coat of ordinary carriage varnish applied (over the lettering) all over the van. This van was still in good condition four years later and showed no signs of peeling or cracking. It is therefore probable that, provided a day or two is permitted to elapse after spraying to allow for the evaporation of solvents, varnishing over cellulose is permissible and provides a good cheap finish.

CELLULOSING SMALL METAL ARTICLES

Cellulose spraying is a good quick method of finishing metal objects such as trays, electric fires, etc., which are done in quantity. The finish required, however, is not so highly polished as in car work and the number of coats is considerably less. The same attention in preparation is necessary and all grease must be removed. Then, with all steel pressed work, one coat of primer is sprayed on, followed by one coat of surfacer. The colour is sprayed on coat by coat until solid.

Such small work is usually done in a specially constructed spray-booth, the work standing on a small turntable or hanging from hooks for convenience.

Finally, the writer would emphasize the fact that there are no short cuts to good cellulose work. It is better to do good work from the outset than to try to overcome a bad reputation acquired by the turning out of "cheap and nasty" work.

GLOSSARY OF TERMS

Blooming. The name given to the haze or film that clouds the surface of the cellulose when spraying is done in a damp workshop.

Cracking or Crazing. An effect similar to crocodile skin due to the new cellulose acting on the old.

Detergent. Having cleansing power.

Flatting. The process whereby the sprayed films of cellulose are levelled to an even surface.

Key. The amount of "hold" the metal affords to the paint film.

Mist Coat. A mist as distinct from a full wet coat of cellulose.

Mordant. Having a biting action to etch the metal with the object of providing a good "key."

Overspray. A coat of thinners tinted with the colour, sprayed on after flatting.

Polychromatic. Having many colours. Polychromatic lacquers have in suspension metal particles of a contrasting colour.

Primer. The first coat applied in any painting operations.

Pumice. Abrasive powder ground from pumice stone.

Rubbing. The operation of cutting down or levelling, filling or stopping.

Stopper. Semi-solid filling paste, either cellulose or oil base.

Surfacer. A partial filler applied after the filler but before the colour.

Swage. A strengthening device employed by metal workers, consisting of a V-sectioned rib rolled into the metal by a machine.

Wet-or-Dry Paper. Another name for waterproof abrasive papers.

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